



MATHEMATICS

Integrated Mathematics

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Introduction

A hallmark of the Michigan Merit Curriculum is the shift from credit based on *seat time* to credit based on *proficiency with the content expectations*. With respect to mathematics, this means that students earn 3 of the 4 required mathematics credits by demonstrating proficiency with mathematics HSCE regardless of when or where they were learned. The 4th credit is at the discretion of the district.

While the Michigan Merit Curriculum legislation requires that the Michigan Department of Education develop course descriptions for the traditional courses of Algebra I, Geometry, and Algebra II, the law also provides local districts with the flexibility to establish the sequence and pace of instruction.¹ *Because the Mathematics High School Content Expectations can be arranged in a myriad of ways to form an integrated sequence of instruction, the Michigan Department of Education (MDE) is not developing course credit documents for integrated math 1, 2, or 3.* Schools are encouraged to design a scope and sequence of instruction that best meets the needs of their students.

Why Integration?

According to the National Council of Mathematics, *Principles and Standards for School Mathematics* instructional programs should enable all students to: recognize and use connections among mathematical ideas; understand how mathematical ideas interconnect and build on one another to produce a coherent whole; and recognize and apply mathematics in contexts outside of mathematics [Connections Standard].² “Multiple strands linked by strong interconnections can develop mathematical power in students with a wide variety of enthusiasms and abilities.”³

Placing mathematics in relevant contexts and helping students see and build the connections between concepts, can be especially useful to those students who typically struggle with mathematics. “Integrated curricula support equity because different branches of mathematics...favor different learning styles, so an entire school year of one branch puts some students at a greater disadvantage than does a more balanced curriculum that includes several areas of mathematics.”⁴ Research suggests that “the new [integrated] mathematics curricula enable more students to do better, but they also decrease the traditional performance gaps between majority and traditionally under-represented minority students, and between low - and high - SES students.”⁵ Regardless of how the expectations are arranged, an integrated mathematics program should be “mathematically rich and challenging and contain engaging tasks drawn from multiple strands.”⁶

Measuring Proficiency⁷

The local district has the flexibility to determine when an assessment(s) is given, as well as develop or select district or state

assessments that measure students' understanding of the content expectations for credit. By April 20, 2009, the Michigan Department of Education must develop or select and approve assessments that school districts and public school academies may use to determine whether a student has successfully completed a credit required by the Michigan Merit Curriculum. The assessments for each credit must measure a student's understanding of the content expectations or guidelines for that credit. The Department must develop or select and approve assessments for at least each of the following credits: Algebra I, Geometry, Algebra II, Earth Science, Biology, Physics, Chemistry, World History and Geography, United States History and Geography, Economics, Civics, and English in grades 9 through 12.

The department is currently naming these Secondary Credit Assessments and they will be developed in two formats: 1) end of course assessments, which can be used for testing out purposes, and 2) testlets or modular tests that could be used as formative assessments throughout instruction. The goal of creating the testlets or modular tests is to permit students who are receiving integrated or applied instruction to be assessed on the state's Secondary Credit Assessments. Districts using an integrated math approach should determine at what point in the integrated math sequence students are ready to be assessed on the course content expectations for Algebra I, etc.

An important element of the Mathematics HSCE is the idea that students will leave high school mathematically proficient. "...it is critical to keep in mind that content knowledge alone will not provide adequate preparation for success in entry-level university courses or entry-level positions in today's workforce. Successful post-secondary engagement requires that students must be able to apply knowledge in new situations; to solve problems by generating new ideas; to make connections between what they read and hear in class, the world around them, and the future... educators must ...develop in students the cognitive skills and habits of mind that will result in mathematical proficiency and successful post-secondary engagement."⁸ An integrated approach to high school mathematics can help develop these "habits of mind." These programs allow students to develop and extend their mathematical content knowledge by seeing mathematical ideas connected to each other and to the real world.

Resources

In addition to the references below, the following is a list of resources that schools may find useful as they consider an integrated approach to the High School Content Expectations.

COMPASS (Curricular Options in Mathematics Programs for All Secondary Students)

<http://www.ithaca.edu/compass>

COMPASS is a secondary school implementation project funded in part by the National Science Foundation whose goal is to assist those interested in improving secondary school mathematics opportunities and experiences for their students.

CSMC (Center for the Study of Mathematics Curriculum)

<http://www.mathcurriculumcenter.org>

The **CSMC** serves the K-12 educational community by focusing scholarly inquiry and professional development around issues of mathematics curriculum. Major areas of work include understanding the influence and potential of mathematics curriculum materials, enabling teacher learning through curriculum material investigation and implementation, and building capacity for developing, implementing, and studying the impact of mathematics curriculum materials.

National Council of Teachers of Mathematics. (2001). *Integrate to make whole*.

<http://www.nctm.org/resources/content.aspx?id=1662>

A collection of essays presenting a variety of viewpoints regarding curriculum integration at all levels, including high school.

Senk, S. & Thompson, D. (Eds.). (2003). *Standards-based school mathematics curricula: What are they? What do students learn?* Mahwah, NJ: Lawrence Erlbaum Associates.

Sutton, J. & Krueger, A. (Eds.). (2002). *EdThoughts: What we know about mathematics teaching and learning*. Aurora, Co: Mid-continent Research for Education and Learning (MCREL).

<http://www.mcrel.org/topics/productDetail.asp?productID=33>

References

¹ Michigan Department of Education (2006a). *Frequently Asked Questions: Michigan Merit Curriculum High School Graduation Requirements* (p.5). Available: <http://www.michigan.gov/highschool>.

² National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics*. Reston, VA: NCTM. Available: <http://standards.nctm.org/index.htm>.

³ Steen, L. (1990). Pattern. In L. Steen (Ed.), *On the shoulder of giants: New approaches to numeracy* (pp 1-10). Available: <http://newton.nap.edu/catalog/1532.html>.

⁴ House, P.A. (2003). Integrated mathematics: An introduction. In S. McGraw. (Ed.), *Integrated mathematics: Choices and challenges* (pp.3-11). Reston, VA: National Council of Teachers of Mathematics (NCTM).

⁵ Schoenfield, A. (2002). Making mathematics work for all children: Issues of standards, testing and equity. *Educational Researcher*, 31, (pp. 13-25). Available: http://www.aera.net/uploadedFiles/Journals_and_Publications/Journals/Educational_Researcher/3_101/3101_Schoenfeld.pdf.

⁶ House, P.A. (p. 5)

⁷ Michigan Department of Education (2006a). (p. 11)

⁸ Michigan Department of Education (2006b). *High school content expectations: Mathematics*. (p. 4). Retrieved from the Michigan Department of Education website: http://www.michigan.gov/documents/Math11-14-open1_142202_7.pdf.